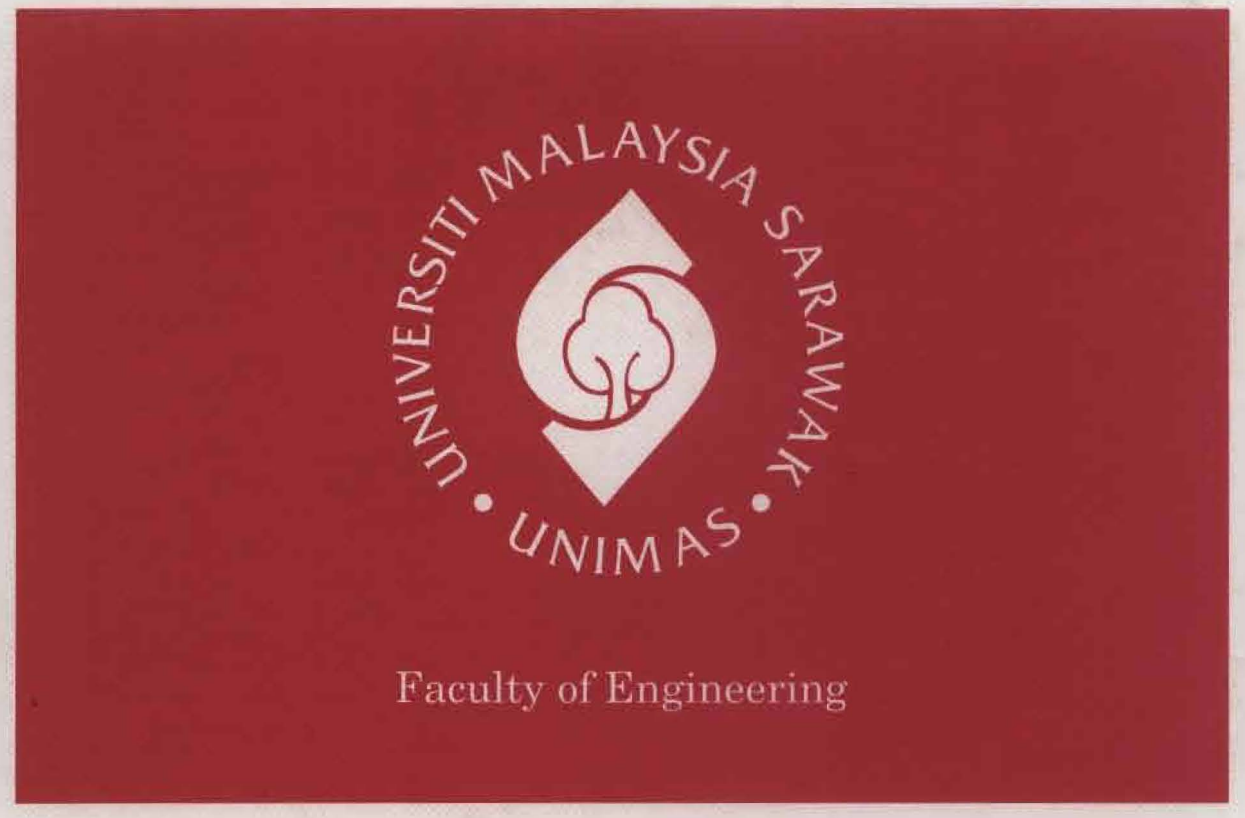

ANTI - THEFT SECURITY APPLICATION USING MICROCONTROLLER

Sebastian Edwin Amin

Bachelor of Engineering with Honours
(Electronics and Computer Engineering)
2004

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SEBASTIAN EDWIN AMIN

This project is submitted in partial fulfilment of
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Dedicated especially
to
my beloved family and love one

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ABSTRACT

Microcontrollers are widely used in many electronic gadgets nowadays. Many of which are embedded in daily domestic appliances such as in microwave ovens, refrigerator, washing machines, just to name a few.

In security and monitoring devices, microcontrollers are well embedded within the system due to its simplicity yet robust performance. This gives an added advantage to users who wish to customize its application according to operational environment needs.

In addition to its simplicity and robust performance, microcontrollers are also inexpensive, easy to modify its programming contents and certainly perfect for applications that runs on real time conditions.

Hence, this project report is intended to illustrate an overview operation of an anti-theft application device. This project will illustrate how external data is extracted and translated into electrical signals, processed accordingly and generates the intended output, while at the same time communicates with other devices via a serial link. This overview is commonly used in security application nowadays, and is a preference of choice.

ABSTRAK

Kebanyakan peralatan elektronik pada masa kini melibatkan penggunaan litar pengawal - mikro. Litar-litar ini boleh didapati dalam pelbagai peralatan domestik harian seperti dalam alat ketuhar gelombang mikro, peti sejuk, mesin pembasuh pakaian, dan banyak lagi.

Penggunaan litar pengawal-mikro amat sesuai digunakan dalam aplikasi peralatan sistem kawalan dan keselamatan kerana ianya mudah disenggara dan difahami penggunaannya, selain mempunyai prestasi yang tinggi. Ini seterusnya memberi kelebihan kepada pengguna untuk membuat perubahan terhadap sistem aplikasinya mengikut keperluan operasi semasa.

Tambahan pula, penggunaan litar pengawal – mikro adalah murah dan senang didapati di pasaran, manakala kandungan aturcaranya yang mudah diubah sememangnya sesuai digunakan untuk aplikasi 'real-time'.

Oleh yang demikian, laporan projek ini adalah bertujuan untuk menunjukkan secara keseluruhannya prototaip sebuah aplikasi sistem keselamatan untuk simulasi keadaan sebenar operasi sistem keselamatan yang terdapat di pasaran. Projek ini akan menerangkan secara mendalam mengenai kaedah pengambilan data dari persekitaran, memproses data tersebut mengikut kehendak litar dan mengeluarkan output yang dikehendaki.

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NOTATIONS

A

ACC	Accumulator
A/D	Analog to Digital
ALU	Arithmetic Logic Unit

C

CMOS	Channel Metal Oxide Semiconductor
CPU	Central Processing Unit

D

DC	Direct Current
DCE	Data Communications Equipment
DPTR	Data Pointer Register
DTE	Data Terminal Equipment

E

$\overline{EA}$	External Access
EPROM	Electronically Programmable Read Only Memory

G

GUI	Graphic User Interface

H

H	Hexadecimal
HMOS	Heated Metal Oxide Semiconductor
Hz	Hertz

I

IC	Integrated Circuit
IDE	Integrated Development Environment
IE	Interrupt Enabled
$\overline{INT}$	Interrupt
I/O	Input/Output
IP	Interrupt Priority

L

LE	Latch Enabled
LED	Light Emitting Diode

M

MCU	Microcontroller Unit
MCS51™	Microcontrollers 51 Family
MS	Microsoft

N

n/c	Normally Close
n/o	Normally Open

O

$\overline{OE}$	Output Enabled
OTPROM	One Time Programmable Read Only Memory

P

PC	Program Counter
PC	Personal Computer
PCON	Power Control
PEROM	Programmable and Erasable Read Only Memory
PSW	Program Status Word

R

RAM	Random Access Memory
R-C	Resistance-Capacitance
$\overline{RD}$	External Data Memory Read Strobe
ROM	Read Only Memory
RST	Reset
RS232	Standard 9-pin PC serial port
R_XD	Receive Serial Input Line

S

SBUF	Serial Buffer
SCON	Serial Condition
SFR	Special Function Register
SMOD	Serial Mode
SP	Stack Pointer
SPST	Single Pole Single Throw

T

T	Timer
TCON	Timer Condition
TL	Timer Low
TH	Timer High
TMOD	Timer Mode
TTL	Transistor-Transistor Logic
T_XD	Transmit Serial Output Line

U

UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

V

VB	Visual Basic
V_{CC}	Voltage Supply
V_{CE}	Voltage Collector – Emitter

W

$\overline{WD}$	External Data Memory Write Strobe
WWW	World Wide Web

Measurement Symbols

A	Ampere
F	Farad
K	Kilo
M	Mega
m	mili
μ	micro
Ω	Ohm
p	piko
V	Volt

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Microcontrollers [1] are widely used in industrial and consumer applications nowadays. In many cases, absolute precision, good performance, precise control and multi-tasking are issues of great concerned. For example, a burglar alarm system is supposed to detect an intruder. It must be able to detect and act upon a variety of situations. With just a microcontroller connected with the proper sensors [2] and actuators, it can do just this and become an effective burglar alarm.

A microcontroller is an embedded computer-on-chip, whereby the processor and its support circuits are embedded together. Hence, this gives an added advantage to a smaller, inexpensive and flexible system design on which a microcontroller can be implemented with ease.

1.2 Project Objectives

The main aim of this project is the integration of different electronics components connected together via a microcontroller to construct an Anti-Theft Security Application. A software program for the alarm is also to be developed, to fully operate the system as required. Below is a summary of the project objectives.

OBJECTIVES OF PROJECT

- Identify key elements in an Anti-Theft Security Application System,
- Integrate different electronics components together,
- Construct an Anti-Theft Security Application using the integration of electronic devices,
- Developed software programs for the required alarm activation,
- Simulate the event on both hardware and software.

This report contains a detailed description of the hardware used, component specifications, schematic diagrams on various components interfaced to the MCS51™ microcontroller, and the program flow chart for the entire circuit operation.

1.3 Project Overview

The purpose of the project is to design a microcontroller based Anti-Theft Security Application. This application will solely detect computer system detachments.

The project will use sensors (magnetic switch sensors) [2] as input detections, while a microcontroller [1] will be used to evaluate the sensed data and take appropriate action.

1.4 Thesis Overview

In the early part of this thesis, the author describes the main purpose of the project, which is to construct an alarm system using a MCS51™ microcontroller. Later in the next chapter, the author will discuss the structure and core fundamentals of a microcontroller based system particularly about the architecture, memory model, and the internal registers. Besides that, descriptions about the input sensors and actuators, peripheral latches, amplifier components as well as the RS232 serial communication will also be rendered in the literature review.

Chapter 3 will discuss the design methodology and development of the project. Details on the hardware and software design procedures and considerations will be discussed in depth in this chapter.

The results and discussions of the project will be rendered in Chapter 4. In this chapter, findings and outcome of the project are detailed in simulation test results (hardware) to provide readers technical information of the analysis done.

The conclusion and recommendation will be in the final chapter of this report. Attached at the end of this thesis report are the project's schematic circuitry, microcontroller's source codes, and the VB6.0 GUI source codes for references. The report's bibliography is also attached for future references if this project is to be improved further.

CHAPTER 2

LITERATURE REVIEW

2.1 THE MCS51™ MICROCONTROLLER

A microcontroller is an embedded computer-on-chip. The Input/Output ports and memory subsystems built in a microcontroller are specialized for control applications. The internal program memory (ROM) stores the control software and the CPU executes the instructions from the ROM. The internal data memory (RAM) allows the CPU to stores intermediate data.

A very popular microcontroller widely used in control applications is the MCS51™ microcontroller, manufactured by Intel ® Corporation [5]. The device has the following core features [5]:

- Single supply 5V operation using HMOS technology
- 4096 bytes program memory on-chip
- 128 bytes program memory on-chip
- 4 register banks
- 128 User-defined software flags
- 64 Kilobytes each program and external RAM addressability
- 1μs instruction cycle with 12 MHz crystal
- 32 bidirectional I/O lines organized as four 8-bit ports
- Multiple mode, high-speed programmable Serial Port

- Two multiple mode, 16-bit Timers/Counters
- Two-level prioritized interrupt structure
- Direct Byte and Bit addressability
- Binary or Decimal arithmetic
- Integrated Boolean Processor for control application

2.1.1 Microcontroller Variants

The MCS51™ microcontroller family [4] comes in a variety of options:

- **Microcontroller with internal mask-programmed ROM**

  Chosen for mass-produced items with a specified program embedded into the device. The advantage of this device is that it is cheap at the retail side but expensive during the initial manufacturing stage.

- **Microcontroller with internal EPROM**

  Chosen for prototyping or developing microcontroller software, which is suitable for short production, runs. This device is relatively expensive because of the built-in memory and has limited programmable/erase cycles.

- **Microcontroller with external program memory**

  Chosen for its cheap cost options and it is useful if the device is used to access other peripherals or additional memory components. However, this will reduce the I/O ports due to extra interface needed to access the program memory.

- **'Shrunk' microcontroller**

  Chosen for its small physical size (0.3 inch pin pitch) where design space is of great concern. This device comes in with an integrated EPROM or OTPROM program memory but the Serial Port feature is not available.

Table 1 below shows a summary of the MCS51™ family variants.

Device	Internal Memory		Timers/ Event Counters	Interrupt
	Program	Data		
8031AH	-	128 x 8 RAM	2 x 18-Bit	5
8051AH	4K x 8 ROM	128 x 8 RAM	2 x 18-Bit	5
8051AHP	4K x 6 ROM	128 x 8 RAM	2 x 18-Bit	5
8751H	4K x 8 EPROM	128 x 8 RAM	2 x 18-Bit	5
8751H-8	4K x 8 EPROM	128 x 8 RAM	2 x 18-Bit	5
8751BH	4K x 8 EPROM	128 x 8 RAM	2 x 18-Bit	5
8032AH	-	128 x 8 RAM	3 x 18-Bit	6
8052AH	8K x 8 ROM	128 x 8 RAM	3 x 18-Bit	6
8752BH	8K x 8 EPROM	128 x 8 RAM	3 x 18-Bit	6

Table 1 MCS51™ Family Variants